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PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Abstract:

This deliverable contains a short report and a list of the student presentations at the final PACO-PLUS meeting in November 2009 in Karlsruhe. These presentations were made in conjunction with the Training aspects of PACO-PLUS to give our PhD students and PostDocs the chance to present their results and to gain praxis in scientific presentations.

Keyword list: Scientific presentations, Training, PhD-Programs.

Executive Summary

In conjunction with the last year's PACO-PLUS meeting we had in total seven presentations from PhD-students and PostDocs from the project.

These presentations were embedded in the general project discussions in order to show progress in the respective WPs.

Presentations were 30 minutes followed by 15 minutes of discussion.

The goal of this was to allow students to present their results, while at the same time remain topic-oriented within the goals of PACO-PLUS. Thus, to keep this focus, we decided to not have more presentations and only present on the most relevant (for PACO-PLUS) work.

The 15-min discussions were held specifically to better understand and embed the work of those students into the context of PACO-PLUS.

Appendix: List of the student presentations

Dirk Kraft

Grounded Object and Grasp Representations

Abstract: We presents a system that is able to learn autonomously about objects and applicable grasps in an unknown environment through exploratory manipulation and to then use this grounded knowledge in a planning setup to address complex tasks. A set of components and how they interact with each other to achieve this learning process is shown. The individual components are: a system to get physical control over unknown objects by creating grasps based on visual feature relations, a method to view an object from multiple sides and build a multi-modal visual object model, a pose estimation procedure based on these models and a procedure to learn a probabilistic grasping model based on exploratory manipulation. We describe the interaction of these modules that form a complex system and what prior knowledge we introduced to achieve the overall system performance. Finally we present our initial implementation of a system that is able to generate and execute plans based on this learned representation.

PhD finished on: Nov. 2009

Renaud Detry

Visu-grasp Object Modalities as Continuous Probability Distributions"

Abstract: We present a multi-modal object model which represents object knowledge in terms of continuous probability distributions. The model integrates vision and grasping modalities. The visual model is a probabilistic expression of object parts through smooth *edge-point distributions* obtained through kernel density estimation on sparse-stereo edge reconstructions. Registration is conducted by nonparametric inference of maximum-likelihood model parameters, using Metropolis--Hastings MCMC with simulated annealing. This mechanism is robust to clutter, and avoids direct model-to-scene correspondences. The grasping model encodes grasp affordances, i.e. relative object-gripper configurations

that yield stable grasps. These affordances are represented probabilistically with *grasp densities*, as continuous density functions defined on the space of 3D positions and orientations. We explore a batch, experience-based learning paradigm where grasps sampled randomly from a density are performed, and an importance-sampling algorithm learns a refined density from the outcomes of these experiences. Our model allows for the suggestion of grasps for a visually detected object. In real-world scenarios, grasp densities are further integrated with hardware physical capabilities (robot reachability) and external constraints (obstacles) in order to select a grasp that has the largest chance of success within the subset of achievable grasps.

PhD planned for: May 2010

Andrej Gams

Online learning and modulating of periodic motion using nonlinear dynamical systems

Abstract: In the talk I will briefly discuss three major topics. The first topic is the control of a non-linear periodic task of spinning a gyroscopic device with a robot, which led into a development of a brand new method of synchronizing the motion of a robot and the actuated device. The second topic covers the development of a similar, but more advanced method of both learning and modulating periodic movements with a two-layered system for motion imitation that extracts the frequency of the demonstration signal and learns only one period of the motion, which we can also easily modulate. The last topic covers a novel approach to generalizing between different periodic movements, and generating new periodic trajectories from a library of previously learned movements.

PhD finished in: April 2009

Alexander Bierbaum

Tactile Exploration Strategies for the Acquisition of Object Representations and Grasping

Abstract: In this talk I will present a tactile exploration strategy for unknown objects using a multi-fingered anthropomorphic robot hand. The strategy is based on dynamic potential fields for motion planning and makes use of virtual model control for resolving the inverse kinematics of the robots hand-arm system. Exploration results for different objects are given. Further, a method for extracting grasp affordances from the 3D point set acquired using tactile exploration will be introduced. In the second part of the talk I will present the developed object model based on superquadric functions and give results for fitting tactile sensor data in simulation and in real world. The final part of the talk is dedicated to the description of the developed sensor system and a finger motion control scheme for the fluidic humanoid robot hand. I will present results for the force position controller and the new tactile sensor system.

PhD planned for: July 2010

Kai Hübner

Grasping by Parts: Robot Grasp Generation from 3D Box Primitives

Abstract: Robot grasping capabilities are essential for perceiving, interpreting and acting in arbitrary and dynamic environments. Grasping is a central issue of various robot applications, especially when unknown objects have to be manipulated or - as a focus of PACO-PLUS - connected to actions performable on them. In this work, we present an approach aimed at the object description constrained by performable actions. In particular, we link box-like representations of objects with the evaluation of grasp hypotheses.

The contributions of this work are two-fold: in terms of shape approximation, we demonstrate a novel algorithm for a 3D box primitive representation to identify object parts from 3D point clouds. We motivate and evaluate this choice particularly towards the purpose of grasping. As a contribution in the field of grasping, we present a grasp hypothesis generation framework that utilizes the box presentation in a highly flexible manner. Several publications point out a number of capabilities and opportunities using box-based grasping strategies.

PostDoc

Haazebroek, Pascal

Interaction between Perception and Action

Abstract: My PhD work focuses on the development and testing of a cognitive architecture that stresses the interaction between perception and action. The architecture is based on the Theory of Event Coding and considers cognitive event representations as Object-Action Complexes (OACs). The model accounts for how feature codes are extracted from, or activated by incoming sensory information, how cognitive action representations are extracted from self-perception, and how object and action features are integrated into coherent event representations. In the presentation I will give an outline of empirical standard findings in cognitive psychology (stimulus-response compatibility, action-effect learning etc) and discuss their consequences for biologically realistic cognitive architectures and cognitive robotics.

PhD planned for: 12/2010

Sanmohan

Discovering human action primitives.

Abstract: With the recent finding of mirror neurons there has been a growing interest in expressing actions as a combination of meaningful subparts called primitives. Primitives could be thought of as an alphabet for the human actions. In this talk we observe that human actions and objects can be seen as being intertwined: We can interpret actions from the way the body parts are moving, but as well from how their effect on the involved object. While human movements can look vastly different even under minor changes in location, orientation and scale, the use of the object can provide a strong invariant for the detection of motion primitives. An unsupervised, model based, learning approach for action primitives that makes use of the human movements as well as the object state changes is presented. Movements that produce the same state change in the object state space are classified to be instances of the same action primitive.

PhD planned for: End of July 2010